ESA-142 Final Public Report

Introduction:

Bayer CropScience at its Institute site generates steam at its two steam plants (SP-#1 & SP-#2) to meet the process & heating steam needs for its own and for its neighboring process plants. Steam is generated at 1000-psig at its three SP-#2 Boilers & 400-psig at its three SP-#! Boilers. Steam is distributed at the site at 400, 200 & 75-psig pressure levels for the various users. The steam load varies between varies between 600klbs/hr in winter and 450klbs/hr in summer. Pulverized Coal is burned at the three SP-#2 Boilers and is the major fuel source contributing 82% of the total BTUs burned at the site. Natural gas is fired in the three SP-#1 Boilers contributing about 15% of the total BTUs burned, while the internal by-product fuels contribute the remaining 3% of the BTUs. During the year 2005, this site spent close to $20 million for purchased coal & natural gas. The Condensate return is only about 30% as the recovery & return system needs maintenance & upgrading.

Objective of ESA: To provide U.S. industries technical assistance targeted to reduce fuel expenditure.

Focus of Assessment:

The focus of Energy (Steam) System Assessment (ESA) is as follows: (1) to identify energy cost reduction opportunities and (2) to train in-plant personnel to continue and sustain the improvements. Since this site consumed about $20 million worth of Coal & Natural gas in 2005, compared to $6 million on electricity, to meet its steam & HVAC needs, this ESA is focused on the steam distribution, the steam users, and the condensate recovery & return at the site.

Approach for ESA:

Learn about the site from the plant contact person(s). With their assistance, collect the relevant energy data, brief them on DoE Steam Tools & help them enter data, identify opportunities for Improvement & evaluate improvement projects with DoE Tools.

General Observations of Potential Opportunities:

During 2005, this plant consumed 4,600,000 MMBtu of coal, 780,000 MMBtu of natural gas & about 283,000MMBtu of internal by-product fuels, for an estimated total cost of $19.3 million dollars in its boilers.

Eight energy cost savings opportunities are identified that would reduce the energy losses and improve the overall steam system efficiency. These savings opportunities are also classified as Near, Medium & Long Term opportunities as defined below:

- Near term opportunities include actions that could be taken as improvements in operating practices, maintenance of equipment, or relatively low cost actions or equipment purchases.
- Medium term opportunities would require purchase of additional equipment and/or changes in the system, such as the addition of recuperative air preheaters, and the use of energy to substitute current practices of steam usage, etc. It would be necessary to carryout further engineering and return on investment analysis.
- Long term opportunities would require testing of new technology and confirmation of performance of these technologies under the plant operating conditions, with economic justification to meet the corporate investment criteria.

During this ESA, eight energy cost savings opportunities were identified and seven of them were assessed using the SSAT model. One of the opportunities to recover wasted heat in Ai compressor cooling has been evaluated by manual calculations. The total estimated annual savings evaluated by SSAT model is $4.3 million. This could bring down the annual utility cost by ~16%.

The energy cost savings opportunities evaluated through SSAT model are listed below;

1. Improve Boiler Efficiency by reducing the excess air levels in SP-#1 Boilers: *(Medium Term)*
   The burners at the 3 operating Boilers are very old and are not capable for low excess air operation. By replacing the burners in 2 of the natural gas only Boilers, the fluegas Oxygen levels could be reduced from 8-10% to 4-5%. Maintaining low excess air operation would improve the efficiency of these high cost fuel fired boilers.
   By improving the efficiency at the SP-#1 Boilers, Bayer CropScience would save $211,000/yr

2. Improve Boiler Efficiency: By installing an LP Economizer at SP-#2 Boilers: *(Long Term)*
   The stack gases from the 3 Boilers #10 , #11 & #12 are routed to a common chimney. The temperature of the flue gases after the existing ESP & Economizers is observed at 430^{o}F, as it enters the common stack. Typically when low sulfur coal is used as the fuel, the stack gas temperature could be dropped to about 300^{o}F. Heat recovery from stack gases would bring down its temperature. This could be achieved by installing an LP economizer at the common flue gas duct before it enters the chimney and the heat sink could be make-up boiler feed water added to the hot lime softener.

By recovering additional heat at the SP-#2 Boilers, Bayer CropScience would save $404,000/yr

3. Install backpressure turbine between 400-psig & 75-psig Steam headers: *(Medium Term)*
   At present, the steam requirement for the 75-psig steam users are supplied by steam from 400-psig header through pressure reducing valves. A large steam turbine (400# > 75#) driven process compressor in the neighboring Dow Chemical plant was taken out of service since the past 1-year. Since reducing steam pressure through valves wastes recoverable mechanical energy, Bayer CropScience engineers are trying to install a 400# > 75# backpressure turbine again for some other drive application.
   By recovering the shaft energy, Bayer CropScience would save $545,000/yr.

Alternatively operating the Boilers at SP-#1 at 75-psig also could be considered..

4. Change Condensate Recovery Rates *(Near Term)*
   At present condensate recovery at the Institute site is only between 30 - 35%, even though the steam use with direct process contact is not very significant (may be less than 20% of total steam supplied).
   To improve the condensate return, the following actions need to be taken;
   1 The damaged East leg condensate return header should be replaced with a suitable new piping.
   2 Condensate from HP & MP steam header traps should be routed to the 75# steam header.
   3 Within process units HP, MP & LP condensate collection system has to be revamped
   By fixing the problems and improving condensate return to 50%, Bayer CropScience would save $710,000/yr.

5. Improve the Steam trap maintenance program *(Near Term)*
   From old steam trap survey records, the Bayer CropScience's Insitute site was having a steam trap population of 6594. Over the years some of the process units were acquired by different owners and some processes had been changed. Steam trap maintenance was deferred for many years due to restriction in manpower & financial resources. The present increase in basic fuel cost, is a compelling reason for the Bayer CropScience management to restart & improve the steam trap maintenance program once again. While improving the trap maintenance, it is recommended to incorporate the new technology trap valve stations to facilitate future maintenance fast & easy.
   By improving the Steam trap maintenance program, Bayer CropScience would save $1,250,000/yr.

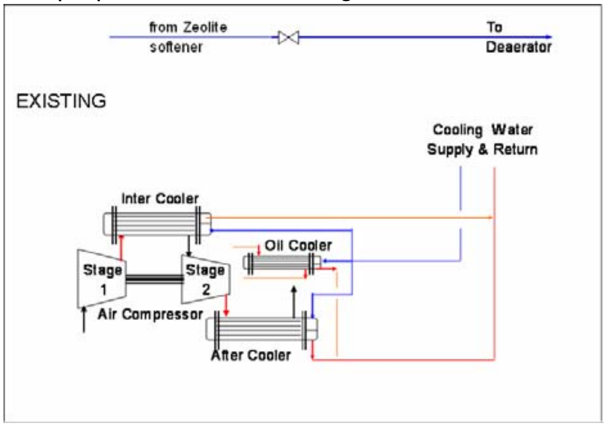
6. Eliminate the leaks in the steam & condensate pipelines *(Near Term)*
   Many steam leaks are observed at the steam & condensate distribution network at the Institute site. This situation must have happened due to the deferred maintenance approach followed during the low energy price periods. However at the present increase in basic fuel cost, Bayer CropScience management is trying to eliminate the steam leaks in the overall steam distribution system.
   By improving the Steam leak maintenance program, Bayer CropScience would save $133,000/yr.

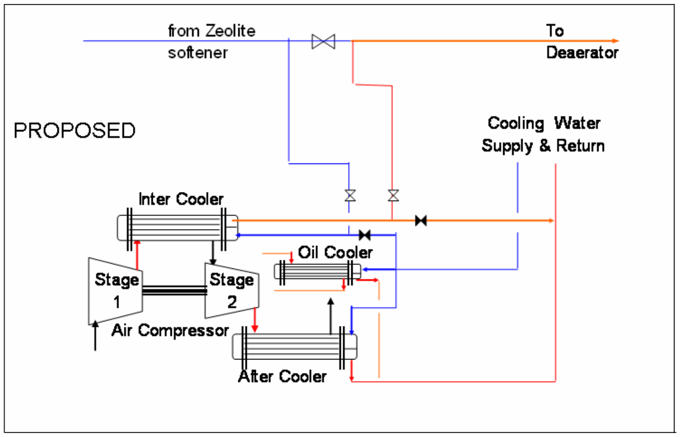
7. Improve Insulation *(Near Term)*
   Most of the steam & condensate pipe line sections have either damaged insulation or insulation removed over them. Asbestos encapsulation was done already for most of the old piping sections.
   By improving the insulation to the bare hot surfaces, Bayer CropScience could save $926,000/yr.

The following additional energy cost savings opportunity could not be evaluated by SSAT model, but recommended due to its technical & economical feasibility.

8. Preheat the make-up soft water to SP #1 by heat recovery from Air Compressors *(Near Term)*
The large Elliot Air-Compressors located across the SP-#1 water softening plant are in service continuously. These compressors are cooled by river water and the warm return water is dumped to the clean water sewer. The cooling water flow from the datasheet indicates between 125 gpm to 256gpm in the 3 heat exchangers. In SP-#1 Boilers cold make-up water from softener is directly added to the Deaerator and heated to about 250°F (sat. temp. @15-psig). Between 20°F to 26°F temperature rise was observed in these heat exchangers. Hence it is recommended to recover this heat by replacing the cooling water with make-up soft water in one of the heat exchangers (Inter-cooler, where the temp. rise was maximum) before it is routed to the Deaerator.
By recovering heat from Air Compressor cooling, Bayer CropScience could save $164,000/yr

Only supply & return piping is required and no pumps are required for this heat recovery modification. The proposed schematic diagram is shown below;





Estimated % of plant's energy cost savings break-up

a) From Near Term opportunities:	73.3%
b) From Medium Term opportunities:	17.4%
c) From Long Term opportunities:	9.3 %

Management Support and Comments:
A corporate level management team encourages any effort that reduces the natural gas usage at all of its plants located around the country. Bayer CropScience's Institute WV site team has shown great enthusiasm towards reducing the natural gas cost of their plant. They are constantly monitoring the natural gas use at the SP-#1 Boilers and already achieved few '**No-natural gas use weeks**' in the recent months.

DOE Contact at Plant/Company: (whom DOE would contact for follow-up regarding progress in implementing ESA results.)

Contact for the total site utility services:
Mr. Thomas W. Dover Phone: 304 767 6101, email: Tom.Dover@bayercropscience.com
Manager, Tenant Services and Public Affairs
Bayer CropScience, Route 25,
Institute, WV 25112.

Contact for ESA coordination & Follow-up:
Dr. Karl F. Bloss, Phone: 304 767 6024 email: karl.bloss@bayercropscience.com
Senior Process Engineer, Engineering,
Bayer CropScience, Route 25,
Institute, WV 25112.